Buckyball superconductors get warmer

As the recent sweltering weather broke records, those 60-carbon molecules called buckyballs set a different kind of temperature standard.

In late May, two research groups announced they had increased by 60 percent the working temperature of an organic superconductor by combining buckyballs – members of a new class of carbon molecules called fullerenes – with the metal rubidium. And this week, four teams shed light on how this fullerene, normally an insulator, can switch to a conductor. Now, the race is on to make buckyballs that superconduct at even higher temperatures.

Matthew J. Rosseinsky and his colleagues at AT&T Bell Laboratories in Murray Hill, N.J., made a thin film of buckyball-rubidium and found it conducted electricity with no resistance at 28 kelvins. This broke a record set at the same lab in April, when researchers made a buckyball-potassium superconductor that worked at 18 kelvins (SN: 4/20/91, p.244). While these materials do not work at as high a temperature as ceramic superconductors, they do function at temperatures much higher than expected, Rosseinsky's group reports in the May 27 PHYSICAL REVIEW LETTERS.

In the May 24 SCIENCE, Károly Holczer and co-workers at the University of California, Los Angeles, describe making fully superconducting samples of potassium-doped buckyballs and producing rubidium-based superconductors that work at 30 kelvins.

Superconductivity seems to arise in these materials because metal atoms so readily share an electron with a neighboring buckyball, two research groups propose in the June 7 SCIENCE. Gunther K. Wertheim's team at Bell Labs suggests that the electrons set up pathways across the thin film, which can then conduct electricity. Paul J. Benning and two colleagues at the University of Minnesota in Minneapolis, working with chemists at Rice University in Houston, draw a similar conclusion based on the energies of the electrons released when the researchers bombarded fullerene solids with light. When there are three metal atoms for each buckyball, this path contains just the right number of electrons for the material to become a superconductor, they report.

Other scientists have found that they can stuff in up to six potassium or cesium atoms per buckyball. X-ray crystallography indicates that the buckyballs shift slightly to accommodate these metals, reports a team headed by John E. Fischer at the University of Pennsylvania in Philadelphia. Normally, buckyballs arrange themselves as if they were corners on a cube, with another buckyball sitting in the center of each face of the cube. When metal is added, the buckyballs on the faces move over to let the new atoms occupy the central positions, the researchers report in the June 6 NATURE.

In the same issue, William A. Goddard III and two students from Caltech in Pasadena calculate the lowest-energy – and consequently, most stable – arrangement of buckyballs in a solid. Their conclusions about how these molecules stack fit with previous results.

Taken together, the recent studies indicate that adding relatively large metal atoms, such as cesium, should result in higher superconducting temperatures. So far, no one has reported getting the cesium-fullerene combination to work, although many are trying. – *E. Pennisi*

Smoking away vitamin C

Cigarette smoking seems to deplete vitamin C levels in the blood. Realizing this, the National Research Council in 1989 revised smokers' recommended daily allowance (RDA) for vitamin C, raising it from 60 milligrams – the RDA for the general population – to 100 mg. But a new study suggests the revised RDA for this vitamin still falls far short of providing smokers the same benefits that nonsmokers get from the general RDA.

As the body's premier scavenger of potentially damaging oxidants and highly reactive molecules called free radicals (SN: 8/26/89, p.133), vitamin C may assist in such important functions as protecting against carcinogens, boosting immunity and preventing heart-disease-fostering changes in fats.

Two years ago, a team led by Gordon Schectman at the Medical College of Wisconsin in Milwaukee published findings suggesting that more than one-quarter of U.S. smokers suffer marginal to severe vitamin C deficiencies. The same team has now studied data on 11,582 people who participated in the second National Health and Nutrition Examination Survey, comparing diets with blood levels of vitamin C. The new findings indicate smokers need more than 200 mg of vitamin C daily in order to lower their risk of deficiency (less than 23 micromoles of vitamin C per liter of blood serum) to the same level as that of nonsmokers consuming 60 mg.

The data show that about 57 percent of nonsmokers eat diets that fulfill their RDA from vitamin C. However, only 27 percent of smokers meet the revised, 100-mg RDA, and only 9 percent consume more than 200 mg per day, the researchers report in the June AMERICAN JOURNAL OF CLINICAL NUTRITION.

For smokers, they conclude, "vitamin supplementation may be necessary to reduce the prevalence of low serum concentrations of vitamin C to rates acceptable in nonsmokers." – *J. Raloff*

'Star Wars' generates sharper stellar images

They were conducting research on laser weapons, not trying to take the twinkle out of starlight. But the "Star Wars" studies that an Air Force laboratory and a university research team began a decade ago – and kept secret until last week – have yielded a laser system that corrects for the atmosphere's blurring of celestial objects. This technology promises to dramatically sharpen the images produced by some ground-based optical telescopes, potentially putting them on a par with costlier instruments that orbit above the interfering atmosphere.

Already tested on small telescopes, the laser system could revolutionize infrared and visible-light astronomy from Earth, its developers reported last week in Seattle at a meeting of the American Astronomical Society.

Ground-based astronomy is handicapped by distortions created when starlight travels through the atmosphere – a turbulent hodgepodge of hot and cold air masses that constantly alters its refractive index. The rapidly changing index deforms the wavefronts of incoming starlight so that the radiation appears to twinkle and come from a fuzzy blob instead of a celestial point.

Astronomers in Europe and Canada have made some headway in solving the problem with adaptive optics. This involves measuring the atmospheric distortion of light coming from a bright, easy-to-measure reference star near the celestial object of interest, then electrically deforming a flexible telescope mirror to optically compensate for the distortion. However, this technique has one key limitation: Most heavenly bodies don't reside near a bright reference star.

Physicists now report they have overcome this limitation by mimicking the effects of a reference star with a powerful laser. The researchers shoot an intense laser beam some 90 kilometers into the atmosphere and measure its resulting distortion as gas particles reflect the light back to Earth.

Although French scientists first publicly described such a theoretical laser-guide system in 1985, Robert C. Fugate says he and his colleagues had secretly conducted the first assays of atmospheric distortions in 1983. Fugate, of the Kirtland Air Force Base in Albuquerque, N.M., reports performing these and later imaging experiments with a 1.5-meter telescope at Kirtland.

Charles A. Primmerman and his group at the Massachusetts Institute of Technol-

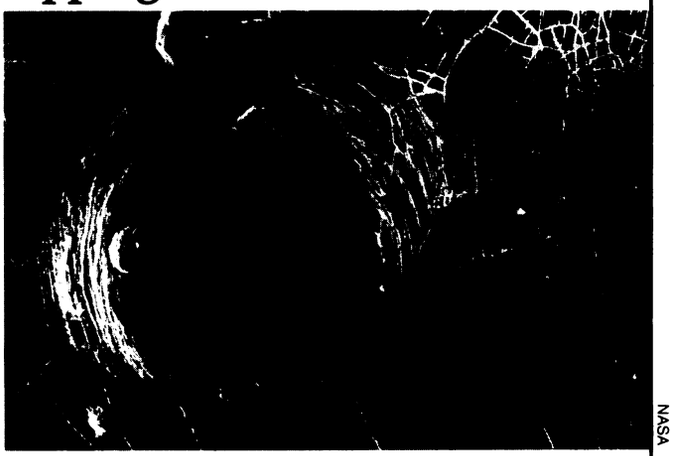
ogy's Lincoln Laboratory in Lexington made the first corrections for atmospheric turbulence with the aid of a laser beam in August 1988, working with a 60-centimeter telescope in Hawaii. The team initially used a laser at the White Sands Missile Range near Las Cruces, N.M., to assess the relatively low-altitude concentrations of nitrogen and oxygen. In 1984, they extended their distortion measurements to the sodium layer, about 90 kilometers above Earth.

Primmerman notes that for best results, astronomers should use both laser light and a true reference star, since lasers cannot compensate for another atmosphere-induced phenomenon called wandering – the apparent movement of an image. He adds that several artificial stars – i.e., laser beams – may be needed to eliminate distortion in flexible-mirror telescopes larger than 10 meters.

Results presented at last week's meeting by Laird A. Thompson of the University of Illinois in Urbana suggest that a laser-based adaptive optics system might give a fairly large telescope – such as the 4-meter telescope on Kitt Peak in Arizona – the viewing quality previously restricted to instruments orbiting above the atmosphere. He calculates that a 4-meter telescope with the laser system could distinguish celestial features about 0.04 arc-seconds apart – roughly twice the resolution expected from the Hubble Space Telescope once its optical flaws are corrected. *– R. Cowen*

Magellan mapping unveils volcanic Venus

NASA released new pictures last week from Magellan's first mapping cycle of Venus, revealing a surface shaped by volcanic activity and scarred with impact craters. Over a span of 243 days ending May 15, the orbiting craft's radar pierced thick clouds to capture detailed images of 84 percent of Venus' surface.



NASA

Scientists think upwelling molten matter created the circular structure, called the Aine corona, that dominates this picture. Two "pancake" domes – one to the north and the other on the western side of the 120-mile-diameter corona – may have arisen from eruptions of extremely thick lava.

"Magellan has removed the veil from the planet Venus. We have now been able to see entirely through Venus' perpetual cloud cover," says Wesley T. Huntress Jr. of the Jet Propulsion Laboratory (JPL) in Pasadena, Calif., who heads NASA's solar system exploration group.

Magellan found no evidence for Earth-like plate tectonics (SN: 5/4/91, p.280), but it did detect a host of unusual volcanic features, including huge lava flows and a formation shaped like a giant tick. Despite the overwhelming evidence of past volcanism, Venus' current status remains unclear. "It's highly probable that volcanism is going on right now, but it's sort of like a mystery novel: Is Venus dead or alive? We need to find the smoking volcano," says geologist James Head of Brown University in Providence, R.I.

Long considered Earth's planetary twin, Venus now appears instead to resemble the Earth of eons ago. "We're starting to realize that Venus may indeed be giving us a look into our past," says Magellan chief scientist R. Stephen Saunders of JPL.

If things go well, Magellan's radar will map all of Venus by the end of its third cycle in September 1992. NASA will then attempt to construct a global gravity map of the planet based on subtle shifts in the craft's altitude. As Magellan travels, its orbit dips and rises slightly in response to variations in gravity, which reflect the different densities of matter within the planet. Thus, the craft can provide not only a look at Venus' surface but also a glimpse into the planet's interior. *– J. Travis*

Gene for inherited retardation found

Physicians currently diagnose fragile X syndrome – the most common inherited cause of mental retardation – by placing a patient's cells under a microscope and scanning for a nearly broken X chromosome whose tip hangs by a flimsy thread. Candidates for the test include not only the mentally retarded but also some healthy individuals who may be "silent carriers," capable of passing the disorder to their children or grandchildren. Unfortunately, the chromosome test spots only 70 to 80 percent of these carriers.

Now, U.S. and Dutch scientists have identified the specific gene involved in fragile X syndrome. Testing for mutations in this gene, they say, should improve physicians' ability to predict whether prospective parents risk having a baby with the disorder.

The researchers – from Emory University School of Medicine in Atlanta, Baylor College of Medicine in Houston, Erasmus University in Rotterdam and Sylvius Laboratory in Leiden – dubbed the gene *FMR*-1, for fragile X mental retardation-1. Although they have not yet discovered the gene's normal function, they note that certain stretches of *FMR*-1 are duplicated many times over in silent carriers and in patients with fragile X syndrome. The duplications disrupt the gene's message, just as repeating words randomly throughout a sentence would make it unreadable. The investigators presume that this disruption can somehow lead to mental retardation.

"This is an advance," says David H. Ledbetter, a Baylor geneticist not involved in the study. The test for the repeated gene "presents a better diagnostic strategy" than chromosome analysis, he says.

To identify individuals carrying the duplications, the researchers chopped up samples of their genetic material and sorted the bits according to length. People with the fragile X gene had extra-long fragments, a telltale sign of duplications.

"We think that repeat region expands by an amplification mechanism that we don't understand yet," says Stephen T. Warren of Emory, who directed the work. He suggests that the amplification makes the X chromosome more fragile.

Warren and his collaborators note in the May 31 CELL that the gene directs the production of a protein bearing multiple positive electrical charges. Because DNA is negatively charged, the protein encoded by this gene could bind to DNA, perhaps regulating other genes.

An understanding of the protein's action may one day point the way to a strategy for reversing fragile X syndrome, Warren says. This form of retardation affects 1 in 1,000 males and 1 in 2,500 females worldwide. Down's syndrome – the leading cause of mental retardation – affects 1 in 600 babies, but subsequent generations cannot inherit it.

Warren's team is now developing a faster screening test, using antibodies to the protein, for routine use in medical laboratories. Only academic medical centers and specialized genetic testing labs are equipped to undertake the complex procedure the researchers used in their study, he says. *– C. Ezzell*